PRODUCTION OF SEMICONDUCTOR DEVICE

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Abstract of **JP9205057**

PROBLEM TO BE SOLVED: To perform collective exposure and development by providing an interlayer separation film of specified material exhibiting photosensitivity similar to that of first and second photoresists between first and second photoresist layers thereby forming a multilayer structure while suppressing the mixing. SOLUTION: A first positive or negative photoresist layer is formed on a semiconductor substrate and a second photoresist layer of the same type is formed thereon. The plurality of photoresist layers are subjected to the same exposing/developing step to form a resist pattern. In this regard, an interlayer separation film having the same photosensitivity as that of first and second photoresists is provided between first and second photoresist layers. The interlayer separation film is formed of a material insoluble to the solvent of second photoresist using a solvent insoluble to the first photoresist layer.

JAPANESE [JP,09-205057,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS

[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1] The 1st photoresist layer which consists of a positive type or a negative-mold photoresist on a semi-conductor substrate, After forming the photoresist layer of two or more layers which consists of the 2nd photoresist layer which consists of a photoresist of the same mold as the 1st photoresist concerned formed on said 1st photoresist layer, In the manufacture approach of the semiconductor device which forms a resist pattern using the same exposure and a development process substantially It consists of the insoluble quality of the material to the solvent of the 2nd photoresist concerned using an insoluble solvent to the 1st photoresist layer concerned. The manufacture approach of the semiconductor device characterized by preparing the demarcation membrane between layers which has the photosensitivity of the same mold as the 1st and 2nd photoresists concerned between the 1st and 2nd photoresist layers concerned.
[Claim 2] The manufacture approach of the semiconductor device of said 2nd photoresist with the sensibility of the 1st photoresist concerned higher than sensibility in claim 1.
[Claim 3] The manufacture approach of a semiconductor device with a larger absorbance [in / on claim 1 and / the exposure wavelength of the 1st photoresist film concerned] than the absorbance of said 2nd photoresist film.
[Claim 4] It is the manufacture approach of a semiconductor device that the demarcation membrane between the layers concerned contains a water soluble polymer compound in claim 1.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the manufacture approach of a semiconductor device.
[0002]
[Description of the Prior Art] There are many problems unsolvable only by high resolution-ization of a resist to LSI integrated highly, and development of various processes is performed. For example, by using the lift-off method, a routing counter can be reduced and a wiring pattern can be obtained. The pattern of a back taper configuration is formed in the lift-off method using the large negative resist of absorption. If a metal is vapor-deposited by making this into a mask and the resist of a back taper configuration is removed, a wiring pattern can be obtained on a substrate. By this technique, by making a resist pattern configuration into a back taper configuration, removal of a resist is made easy and the dry area of the edge of the pattern of metal wiring is stopped. If the positive resist was used, it could not realize, but this back taper configuration had the problem that the resist to be used was restricted.
[0003] Moreover, recently, dimension control of a pattern has become important with detailed-izing, and the process which reduces the reflected light is used by preparing an extinction layer in a resist front face or a substrate interface.
[0004] The cause which worsens a dimension controllability is mainly two, and is the halation from multiplex cross protection and a level difference. There is an approach using an antireflection film (ARC:AntiReflective Coating) as an approach of preventing these reflected lights. What is applied on the surface of a resist (TARC:Top ARC), and the thing (BARC:Bottom ARC) used for a substrate interface are used. Although the former is effective in multiplex cross protection, there is no effectiveness in halation. Although the latter is effective in both, since it is an ingredient without photosensitivity in itself, it performs a pattern imprint by anisotropy dry etching (JP,59-93448,A, JP,60-227254,A). There is a fault that the process of dry etching increases, by this approach.
[0005]
[Problem(s) to be Solved by the Invention] For example, in order to realize a back taper configuration using a positive resist by the lift-off method, it is possible if sensibility has distribution in the direction of thickness. From the upper part, if the resist near a substrate is high sensitivity, lower development progresses and it can predict that the pattern of the configuration where the lower part became thin is obtained. Since it is difficult, as for forming the concentration gradient of a sensitization agent in the direction of the inside of the film, it is effective to form the two-layer structure of the resist from which sensibility differs.
[0006] Moreover, in order to mention a dimension controllability, an antireflection film (BARC) is required for the interface of the resist and reflective substrate which carry out patterning. The two-layer structure of the extinction layer and resist which have photosensitivity instead of BARC depending on the dry pattern imprint depended dirtily enables one-shot exposure and development, and is effective in improvement in a dimension controllability at a small routing counter.
[0007] If the two-layer structure of the resist in these processes is realized, one-shot exposure and

development will be attained the same by much more resist. However, mixing will be accompanied by applying a resist on the film by which software BEKU was actually carried out, and it will spoil the original function of a resist. To a resist solvent, it is insoluble and, as for being [of a resist] effective in distinguishing by different color with, the meltable resin thin film is reported to the alkali developer (JP,63-202026,A). However, this thin film is not fit for formation of a detailed pattern, in order that exfoliation may break out between the 1st and 2nd resist, in order to dissolve isotropic at the time of development.

[0008] The purpose of this invention controls mixing, forms multilayer structure, and is to offer the manufacture approach of the semiconductor device which enables one-shot exposure and development.

[0009]

[Means for Solving the Problem] The following configurations can attain the above-mentioned purpose.

[0010] (1) The 1st photoresist layer which consists of a positive type or a negative-mold photoresist on a semi-conductor substrate, After forming the photoresist layer of two or more layers which consists of the 2nd photoresist layer which consists of a photoresist of the same mold as said photoresist formed on the 1st photoresist layer concerned, By the manufacture approach of the semiconductor device which forms a resist pattern using the same exposure and a development process substantially It consists of the insoluble quality of the material to the solvent of the 2nd photoresist concerned using an insoluble solvent to the 1st photoresist layer concerned. The manufacture approach of the semiconductor device characterized by preparing the demarcation membrane between layers which has the photosensitivity of the same mold as the 1st and 2nd photoresists concerned between the 1st and 2nd photoresist layers concerned.

[0011] (2) The manufacture approach of the semiconductor device characterized by the sensibility of the 1st photoresist concerned being higher than the sensibility of said 2nd photoresist by the manufacture approach of the semiconductor device the above-mentioned (1) publication.

[0012] (3) The manufacture approach of the semiconductor device characterized by the absorbance in the exposure wavelength of the 1st photoresist film concerned being larger than the absorbance of said 2nd photoresist film by the manufacture approach of the semiconductor device the above-mentioned (1) publication.

[0013] (4) It is the manufacture approach of the semiconductor device characterized by the demarcation membrane between the layers concerned containing a water soluble polymer compound by the manufacture approach of the semiconductor device the above-mentioned (1) publication.

[0014] The negative resist which contains the alkali fusibility high molecular compound which has a ring, and an azide compound as an example of the 1st and 2nd photoresist used by the pattern formation approach of this invention can be mentioned. As for the alkali fusibility giant molecule which has a ring here, novolak resin, halogenation novolak resin, a polyvinyl phenol, acetone-pyrogallol resin, a styrene maleic anhydride copolymer, etc. are mentioned. Moreover, as for a diazido compound, azide compounds, such as a bis-azide [, such as 4 and 4'-diazido -3 and a 3'-dimethoxy biphenyl,] and 4-azide-2'-hydroxy chalcone, are mentioned. These azide compounds can be used in independence or two or more sorts of combination.

[0015] Moreover, the example of the 1st and 2nd photoresists used by this invention can mention the negative resist to which alkali fusibility decreases by heat-treatment after pattern exposure or pattern exposure, and exposure including the alkali fusibility high molecular compound which has a ring, and the compound which generates an acid by the exposure of an activity radiation. As for the alkali fusibility giant molecule which has a ring here, novolak resin, halogenation novolak resin, a polyvinyl phenol, acetone-pyrogallol resin, a styrene maleic anhydride copolymer, etc. are mentioned. As for the compound which generates an acid by the exposure of an activity radiation, onium salts, sulfonates, and ~~the nitrobenzyl ester of a sulfonic acid are mentioned. A condensing agent [like a hexamethoxy methyl~~ melamine, diphenyl silane diol, and hydrobenzoin] whose compound which decreases the alkali solubility of a resist is is mentioned by the heat-treatment after pattern exposure or pattern exposure, and exposure. It is easy to adjust sensibility by changing the amount of the compound which generates an acid by exposure with such an ingredient.

[0016] The example of the 1st and 2nd photoresist used by this invention can mention the positive resist containing the alkali fusibility high molecular compound which has a ring, and a quinone diazide compound. As for the alkali fusibility giant molecule which has a ring here, novolak resin, halogenation novolak resin, a polyvinyl phenol, acetone-pyrogallol resin, a styrene maleic anhydride copolymer, etc. are mentioned. Moreover, as for a quinone diazide compound, 1 of polyhydroxy compounds, such as 2, 3, and 4-trihydroxy benzophenone, and an ester compound with 2-naphthoquinonediazide-5-(and/or, -4-) sulfonyl chloride are mentioned. These quinone diazide compounds can be used in independence or two or more sorts of combination.

[0017] Moreover, the 1st and 2nd photoresists used by this invention can mention the photoresist of the positive type with which alkali fusibility increases by heat-treatment after pattern exposure or pattern exposure, and exposure including the compound which generates an acid by the exposure of an activity radiation, and the high molecular compound which has a ring. The ingredient with which the example of such an ingredient contains the compound which protected the alkali fusibility radical of the low molecular weight compound of the phenol resin of the compound which generates an acid by exposure of onium salts, sulfonates, and the nitrobenzyl ester of a sulfonic acid, the ingredient containing what protected the hydroxyl group of alkali soluble phenol resin by the t-butoxycarbonyl group, the tetrahydropyranyl group, etc., the compound which generates an acid by the above-mentioned exposure, and alkali fusibility, and alkali fusibility, or a high molecular compound by the t-butoxycarbonyl group, the tetrahydropyranyl group, etc. is mentioned. It is easy to adjust sensibility by changing the amount of the compound which generates an acid by exposure with such an ingredient.

[0018] By setting up more highly than the 2nd photoresist the sensibility of the 1st photoresist used by this invention, the configuration which lengthened the taper can be prevented and can obtain the multilayer-resist pattern of a good configuration. Moreover, the pattern of a back taper (mushroom configuration) suitable for the lift-off method can be obtained by setting up the sensibility of the 1st photoresist still more highly than the 2nd photoresist.

[0019] In order to raise the absorbance in the exposure wavelength of the 1st photoresist used by this invention, by adding the following extinction agents to the above photoresists, it can use as a photosensitive antireflection film.

[0020] As for an extinction agent, ingredients, such as a triazole system, monoazo, a coumarin system, a pyrazolone system, an imidazoline system, an azomethine system, a stilbene system, an acenaphthene system, a benzophenone system, a chalcone system, an anthracene system, and a benzylidene indene system, are mentioned.

[0021] It is good for the 1st photoresist used by this invention to use the extinction agent which has a phenolic hydroxyl group as an above-mentioned extinction agent in order to be high sensitivity from the 2nd photoresist. Such an extinction agent accelerates the dissolution rate of a photoresist by addition to a photoresist. Therefore, in the case of the photoresist of a positive type, it is effective in forming appearance high sensitivity and the 1st photoresist high-sensitivity-izing from the 2nd photoresist.

[0022] In addition, an extinction agent is not the object limited to these, and if molar extinction coefficient epsilon in exposure wavelength is a thing more than 1,000 (l/cm-mol), does not sublimate at the time of heat treatment of prebaking of a photoresist etc. and does not have a bad influence on the sensitization property of a photoresist, and a dissolution property, it can be used.

[0023] These extinction agents may be used independently, and two or more sorts can be mixed and they can also be used. Moreover, covalent bond of these extinction agents can be carried out to the high molecular compound contained in the 1st photoresist, and they can also be used for it.

[0024] An insoluble solvent is used to the 1st photoresist layer concerned used by this invention. To the demarcation membrane between layers which consists of the insoluble quality of the material to the solvent of the 2nd photoresist concerned, and has the photosensitivity of the same mold as the 1st and 2nd photoresists concerned The ingredient to which the solubility over an ant potash developer is changed by diffusion of the catalyst from the 1st and 2nd photoresist is mentioned at the time of the heat-treatment after the ingredient which has photosensitivity independently, pattern exposure or pattern exposure, and exposure.

[0025] The demarcation membrane ingredient between layers which has photosensitivity independently One or two-mol% of the hydroxyl group of polyvinyl alcohol The formyl styryl pyridinium salt substitution product, polyvinyl alcohol:100 weight section, 4, and 4'-diazido stilbene -2, the water-soluble resist which consists of the 2'-disulfon acid disodium salt:10 weight section, the polyvinyl alcohol:100 weight section, 4, The 4'-diazido stilbene -2, 2'-disulfon acid : The water-soluble resist, polyvinyl alcohol which consist of a water-soluble resist [which consists of the 10 weight sections], acrylamide diacetone acrylamide copolymer:100 weight section, 4, and 4'-diazido stilbene -2, and the 2'-disulfon acid disodium salt:10 weight section : The water-soluble resist which consists of the 100 weight sections, the hexamethoxy methyl melamine:40 weight section, and the diphenyliodonium triflate:5 weight section is mentioned. Moreover, the water soluble polymer ingredient which consists of the water soluble polymer ingredient which consists of the polyvinyl alcohol:100 weight section and the hexamethoxy methyl melamine:40 weight section, the polyvinyl alcohol:100 weight section, and the triethylene-glycol-divinyl-ether:30 weight section is mentioned to the demarcation membrane between layers to which the solubility over an ant potash developer is changed by diffusion of the catalyst from the 1st and 2nd photoresist at the time of the heat-treatment after pattern exposure or pattern exposure, and exposure.

[0026] since the solubility over an alkali developer changes with exposure efficiently when the demarcation membrane between layers to which the solubility over an ant potash developer is changed by diffusion of the catalyst from the 1st and 2nd photoresist is used at the time of the heat-treatment after the demarcation membrane between layers which has photosensitivity and pattern exposure or pattern exposure, and exposure -- sufficient anisotropy development -- going on -- a developer -- sinking in -- it is stopped.

[0027]

[Embodiment of the Invention]

(Example 1) It is 0.2mm of apertures about this after dissolving m, p-cresol novolak resin:100 weight section, 4, and 4'-diazido -3, the 3'-dimethoxy biphenyl:30 weight section, and the extinction agent 2-hydroxy chalcone:30 weight section in a cyclohexanone and preparing a solid content concentration about 20 wt(s)% solution. It filtered using the Teflon MEMBU rem filter, and the 1st photoresist solution was obtained. After dissolving m, p-cresol novolak resin:100 weight section, 4, and 4'-diazido -3 and the 3'-dimethoxy biphenyl:30 weight section in the cyclohexanone and preparing a solid content concentration about 20 wt(s)% solution, this was filtered using the Teflon MEMBU rem filter of 0.2 micrometers of apertures, and the 2nd photoresist solution was obtained. It is 0.4 micrometers of apertures about this after preparing a PVA-formyl styryl pyridinium salt [solid content concentration 1wt% of] water solution. It filtered using the MEMBU rem filter and the demarcation membrane ingredient between layers was obtained.

[0028] The 90 degrees C of the 1st photoresist solutions of the above-mentioned presentation are heat-treated for 5 minutes after dropping and rotation spreading on a silicon substrate, and it is 0.25 micrometers of thickness. The 1st resist film was formed. next, the demarcation membrane ingredient between layers of the above-mentioned presentation -- the 1st photoresist film top -- dropping -- it heat-treated for 5 minutes and 90 degrees C of demarcation membranes between [of 50nm of thickness] layers were formed on the 1st photoresist film. Then, the 90 degrees C of the 2nd photoresist solutions of the above-mentioned presentation are heat-treated for 5 minutes after dropping and rotation spreading on the photosensitive water soluble polymer film, and it is 0.25 micrometers of thickness. The 2nd resist film was formed and multilayers were obtained. It is helium-Xe of 500W after rotation spreading. After exposing two times 120 mJ/cm through a 365nm filter on a lamp, negatives were developed for 200 seconds using the tetramethylammonium hydroxide 2.38wt% water solution, and the pattern was obtained. The acquired pattern configuration was good. Moreover, when patterning was performed on the substrate substrate which has a level difference, the pattern dimensional change was small, and it turned out that there is the acid-resisting effectiveness.

[0029] 1-ethoxyethyl-ized Pori of 48% of rates of the formation of 1-ethoxyethyl (p-vinyl phenol) : (Example 2) The 100 weight sections, 1 and 2, the 3-Tori (methane sulfonyloxy) benzene:3 weight

section, and the extinction agent screw (4-hydroxy benzylidene acetyl) benzene:30 weight section It is 0.2 micrometers of apertures about this after dissolving in a cyclohexanone and preparing a solid content concentration about 10 wt(s)% solution. It filtered using the Teflon MEMBU rem filter, and the 1st photoresist solution was obtained. 1-ethoxyethyl-ized Pori of 48% of rates of the formation of 1-ethoxyethyl (p-vinyl phenol): It is 0.2 micrometers of apertures about this after dissolving the 100 weight sections, 1 and 2, and 3-Tori (methane sulfonyloxy) benzene:3 weight section in a cyclohexanone and preparing a solid content concentration about 10 wt(s)% solution. It filtered using the Teflon MEMBU rem filter, and the 2nd photoresist solution was obtained. Polyvinyl alcohol: It is 0.4 micrometers of apertures about this after preparing the 100 weight sections and triethylene-glycol-divinyl-ether:30 weight section [solid content concentration 1wt% of] water solution. It filtered using the MEMBU rem filter and the demarcation membrane ingredient between layers was obtained.

[0030] The 90 degrees C of the 1st photoresist solutions of the above-mentioned presentation are heat-treated for 5 minutes after dropping and rotation spreading on a silicon substrate, and it is 0.3 micrometers of thickness. The 1st resist film was formed. next, the demarcation membrane ingredient between layers of the above-mentioned presentation -- the 1st photoresist film top -- dropping -- it heat-treated for 5 minutes and 90 degrees C of demarcation membranes between [of 50nm of thickness] layers were formed on the 1st photoresist film. Then, the 90 degrees C of the 2nd photoresist solutions of the above-mentioned presentation are heat-treated for 5 minutes after dropping and rotation spreading on the water soluble polymer film, and it is 0.3 micrometers of thickness. The 2nd resist film was formed and multilayers were obtained. It is Xe-Hg of 500W after rotation spreading. After exposing two times 6 mJ/cm through a 365nm filter on a lamp, negatives were developed for 60 seconds using the tetramethylammonium hydroxide 2.38wt% water solution, and the pattern was obtained. The acquired pattern configuration was good. Moreover, when patterning was performed on the substrate substrate which has a level difference, the pattern dimensional change was small, and it turned out that there is the acid-resisting effectiveness.

[0031]

[Effect of the Invention] Maintaining a process routing counter by applying the manufacture approach of the semiconductor device by this invention, it excels in a dimension controllability and a good pattern without a taper can be obtained.

[Translation done.]